

CLAIMS

What is claimed is:

1. A bone cement mixing and delivery assembly for delivering a bone cement, said assembly comprising:

5 a cartridge having a distal end and a proximal end and defining a chamber between said distal end and said proximal end;

 a lid connected to said proximal end and having an aperture;

 a piston disposed in said chamber for transferring said bone cement from said chamber to said proximal end;

10 a transfer mechanism adjacent to said distal end and in sealing engagement with said cartridge, said transfer mechanism moving said piston through said chamber; and

 a plunger extendable from said piston for forcing said bone cement through said aperture.

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2. An assembly as set forth in claim 1 wherein said transfer mechanism includes a first advancement mechanism for advancing said piston and said plunger in unison

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3. An assembly as set forth in claim 2 wherein said transfer mechanism includes a second advancement mechanism for advancing said plunger relative to said piston.

4. An assembly as set forth in claim 3 further including a delivery cartridge having a cartridge end connected to said aperture and extending to an open end with a smaller diameter than said chamber, said plunger having a cross section permitting the plunger to extend through said aperture and into said delivery cartridge.

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5. A bone cement mixing and delivery assembly for mixing a powdered copolymer and a liquid monomer to form a bone cement and delivering the bone cement, said assembly comprising:

a cartridge having a distal end and a proximal end and defining a chamber
5 between said distal end and said proximal end;

a lid connected to said proximal end and having an aperture;

a piston disposed in said chamber and presenting a face for transferring the bone cement from said chamber to said proximal end;

a plunger moveable relative to said piston for extending from said piston
10 and into said aperture for forcing the bone cement through said aperture; and

a transfer mechanism connected to said distal end of said cartridge for moving said piston and said plunger in unison to a stop position that limits further movement of said piston and thereafter moves said plunger relative to said piston and into said aperture.

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6. An assembly as set forth in claim 5 wherein said transfer mechanism includes a cap surrounding said distal end and a first advancement mechanism interconnected between said cap and said distal end for moving said piston and said plunger in unison and a second advancement mechanism for moving said plunger
20 relative to said piston.

7. An assembly as set forth in claim 6 wherein said first advancement mechanism includes male threads on said distal end and female threads inside said cap threadably engaging said male threads for moving said cap axially over said cartridge upon rotation of said cap relative to said cartridge.

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8. An assembly as set forth in claim 6 wherein said second advancement mechanism includes coaxing threads interconnecting said plunger and said piston for moving said plunger axially relative to said piston in response to rotation of said cap at said stop position.

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9. An assembly as set forth in claim 7 wherein said second advancement mechanism includes a rack on said plunger and a gear engaging said rack to move said plunger relative to said piston upon rotation of said gear.

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10. An assembly as set forth in claim 7 wherein said cap includes a stem and said piston is rotatably supported on said stem, a pin system interconnecting said piston and said stem for preventing relative rotation between said piston and said stem until said piston moves to said stop position, said first advancement mechanism includes a disconnect system for disconnecting said female threads from said male threads for allowing rotation of said cap relative to said cartridge without relative axial movement therebetween at said stop position.

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11. An assembly as set forth in claim 10 wherein said disconnect system includes an annular recess in said cartridge adjacent said male threads and a plurality

of circumferential segments forming said female threads and a first biasing device for moving said segments radially into said annular recess at said stop position.

12. An assembly as set forth in claim 10 wherein said first advancement
5 mechanism includes a tongue and a groove interconnecting said plunger and said stem for rotating said plunger with said stem while allowing said plunger to move axially relative to said stem.

13. An assembly as set forth in claim 10 wherein said pin is disposed radially
10 to interconnect said stem and said piston, a second biasing device for urging said pin out radially and into engagement with said cartridge, said cartridge having a channel adjacent said proximal end for receiving said pin at said stop position to prevent rotation of said piston and thereby to cause axial movement of said plunger relative to said piston in response to rotation of said cap at said stop position.

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14. An assembly as set forth in claim 5 further comprising at least one indicator indicating an amount of the bone cement to be delivered upon rotation of said second advancement mechanism.

20 15. An assembly as set forth in claim 5 further comprising a vent connected to said lid for removing gas particles from said chamber.

16. An assembly as set forth in claim 15 further comprising a filter disposed within said vent for filtering said gas particles.

17. An assembly as set forth in claim 5 further comprising a cooling chamber positioned adjacent said chamber for receiving a cooling fluid to cool said chamber.

5 18. An assembly as set forth in claim 5 further comprising a removable handle extending through said aperture and having a first end and a second end.

 19. An assembly as set forth in claim 18 wherein said removable handle is coextensive with said plunger whereby actuation of said transfer mechanism extends
10 said plunger from said piston.

 20. An assembly as set forth in claim 19 further comprising a pivot interconnecting said plunger and said removable handle for allowing said removable handle to extend at a right angle from said plunger.

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 21. An assembly as set forth in claim 20 further comprising a cap stop extending from said transfer mechanism and positioned for engagement with said removable handle when said removable handle is positioned at a right angle to said plunger whereby said removable handle aids in rotation of said transfer mechanism.

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 22. An assembly as set forth in claim 18 further comprising a mixing blade releasably attached to said removable handle.

23. An assembly as set forth in claim 22 further comprising a quick-release connector between said mixing blade and said removable handle.

24. A method of delivering a bone cement from a cartridge having a distal end and a proximal end defining a chamber therebetween and an aperture in the proximal end, said method comprising the steps of:

filing a chamber having a proximal end with the bone cement;

5 advancing a piston and a plunger in unison within the chamber for transferring the bone cement out of an aperture in the proximal end of the chamber; and

 advancing the plunger independently of the piston to extend the plunger beyond the piston and into the aperture.

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25. A method as set forth in claim 24 wherein the bone cement further includes a liquid monomer and a powdered copolymer and further including the step of disposing the liquid monomer and the powdered copolymer into the chamber.

15 26. A method as set forth in claim 25 further including the step of agitating the liquid monomer and the powdered copolymer to form the bone cement.

27. A method set forth in claim 24 further including the step of venting the chamber and removing gas particles from the chamber.

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28. A method set forth in claim 27 further including the step of filtering the gas particles as the gas particles are removed from the chamber.

29. A bone cement mixing and delivery assembly for mixing a powdered copolymer with a liquid monomer to form a bone cement and delivering the bone cement, said device comprising:

a cartridge having a distal end and a proximal end and defining a mixing
5 chamber between said distal end and said proximal end;

a lid connected to said proximal end and having an aperture;

a removable handle extending through said aperture and having a first end
and a second end defining a hollow cavity between said first end and said second end;

a shaft disposed within said hollow cavity and extending from said first
10 end of said removable handle;

a mixing blade having a bore and said bore receiving said first end of said
removable handle; and

a quick-release connector between said mixing blade and said shaft such
that said mixing blade is releasable from said removable handle.

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30. An assembly as set forth in claim 29 wherein said quick-release connector
further comprises a release button engaging said shaft and being moveable between a
locked and an unlocked position for locking and unlocking said mixing blade to said
removable handle.

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31. An assembly as set forth in claim 30 wherein said quick-release connector
further comprises a flange extending from said bore of said mixing blade and a flange
recess disposed in said first end of said removable handle such that in said unlocked
position said flange engages said flange recess.

32. An assembly as set forth in claim 31 wherein said shaft further comprises a blade attachment end extending through said bore, said blade attachment end having a projection for engaging said flange wherein engagement of said flange occurs when said release button is in said locked position and said flange is in said flange recess.

33. An assembly as set forth in claim 32 further including a piston disposed in said mixing chamber and presenting a face for transferring the bone cement from said mixing chamber to said proximal end.

34. An assembly as set forth in claim 33 further including a plunger moveable relative to said piston for extending from said piston and into said aperture for forcing the bone cement through said aperture.

35. An assembly as set forth in claim 34 further including a transfer mechanism connected to said distal end of said cartridge for moving said piston and said plunger in unison to a stop position that limits further movement of said piston and thereafter moves said plunger relative to said piston and into said aperture.

36. An assembly as set forth in claim 35 wherein said transfer mechanism includes a cap surrounding said distal end and a first advancement mechanism interconnected between said cap and said distal end for moving said piston and said

plunger in unison and a second advancement mechanism for moving said plunger relative to said piston.

37. An assembly as set forth in claim 36 wherein said first advancement
5 mechanism includes male threads on said distal end and female threads inside said cap threadably engaging said male threads for moving said cap axially over said cartridge upon rotation of said cap relative to said cartridge.

38. An assembly as set forth in claim 37 wherein said second advancement
10 mechanism includes coacting threads interconnecting said plunger and said piston for moving said plunger axially relative to said piston in response to rotation of said cap at said stop position.

39. An assembly as set forth in claim 29 further comprising a vent connected
15 to said lid for removing gas particles from said mixing chamber.

40. An assembly as set forth in claim 39 further comprising a filter disposed within said vent for filtering said gas particles.

20 41. An assembly as set forth in claim 29 further comprising a cooling chamber positioned adjacent said mixing chamber for receiving a cooling fluid to cool said mixing chamber.

42. An assembly as set forth in claim 30 wherein said quick-release connector further comprises a collapsible ball extending from said first end of said removable handle and engaging said mixing blade such that in said unlocked position said collapsible ball collapses thereby releasing said mixing blade.

43. A method of mixing a powdered copolymer and a liquid monomer to form a bone cement in a cartridge having a distal end and a proximal and defining a mixing chamber therebetween with a removable handle having a release button and a quick-release connector for attachment to a mixing blade and a lid having an aperture
5 connected to the proximal end, said method comprising the steps of:

disposing the powdered copolymer and the liquid monomer into the mixing chamber;

connecting the lid to the proximal end to seal the mixing chamber having the mixing blade disposed within the mixing chamber;

10 agitating the powdered copolymer and the liquid monomer with the mixing blade by manipulating the removable handle to form the bone cement; and

actuating the release button and releasing the mixing blade from the quick-release connector such that the removable handle is removable through the aperture and the mixing blade remains in the mixing chamber.

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44. A method as set forth in claim 43 wherein the quick-release connector further includes a shaft disposed within the removable handle and connected to the release button and wherein the step of actuating the release button further comprises the step of sliding the release button and rotating the shaft to unlock the mixing blade
20 from the removable handle.

45. A method as set forth in claim 43 wherein the step of connecting the lid further comprises the step of inserting the removable handle through the aperture of the lid prior to connecting the lid to the proximal end.

46. A method as set forth in claim 45 wherein the step of connecting the lid further comprises the step of attaching the mixing blade to the shaft while the release button is in the unlocked position and sliding the release button to a locked position
5 for locking the mixing blade to the removable handle such that mixing blade is on one side of the lid, and it enters the mixing chamber as the lid is connected.

47. A method as set forth in claim 43 further comprising the step of removing gas particles from the mixing chamber.

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48. A method as set forth in claim 47 further comprising the step of filtering the gas particles as the gas particles are being removed from the mixing chamber.